Eldorado National Forest
Cumulative Off-site Watershed Effects (CWE) Analysis Process

Introduction

This document outlines the current process used on the Eldorado National Forest to evaluate susceptibility of adverse Cumulative Off-site Watershed Effects (CWE). Pacific Southwest Region has provided a conceptual model to assess CWE (USDA-FS, 1987a). In 1988, a methodology based on this conceptual model was developed for use on the Eldorado National Forest (Kuehn and Coboum, 1989). See the above documents for a description and assumptions of the model. The current CWE analysis process was developed in 1993. This process is based on Kuehn and Coboum's methodology. Interdisciplinary teams modified Kuehn and Coboum's methodology to address specific issues, such as grazing and the urban interface, that were not considered in the 1988 process. Other major modifications include a refinement of the Natural Sensitivity Index calculation, adjustment of ERA coefficients for automation on a personal computer and a framework for using the ERA/TOC comparison as a screen to assess CWE risk.

The format of this document is an outline of the process with a brief narrative description and a compilation of supporting documentation for each step.

Process Outline

Exhibit 1 on the following page is a flowchart of the CWE analysis model process. There are basically 6 steps in the process:

1. Identify beneficial uses of water and determine the water quality criteria necessary to protect each use.

2. Determine watershed size for analysis.

3. Determine Natural Sensitivity and watershed tolerance to land use by:
   a) describing watershed characteristics.
   b) identifying important hillslope and channel attributes.
   c) identifying probable mechanisms for CWE.

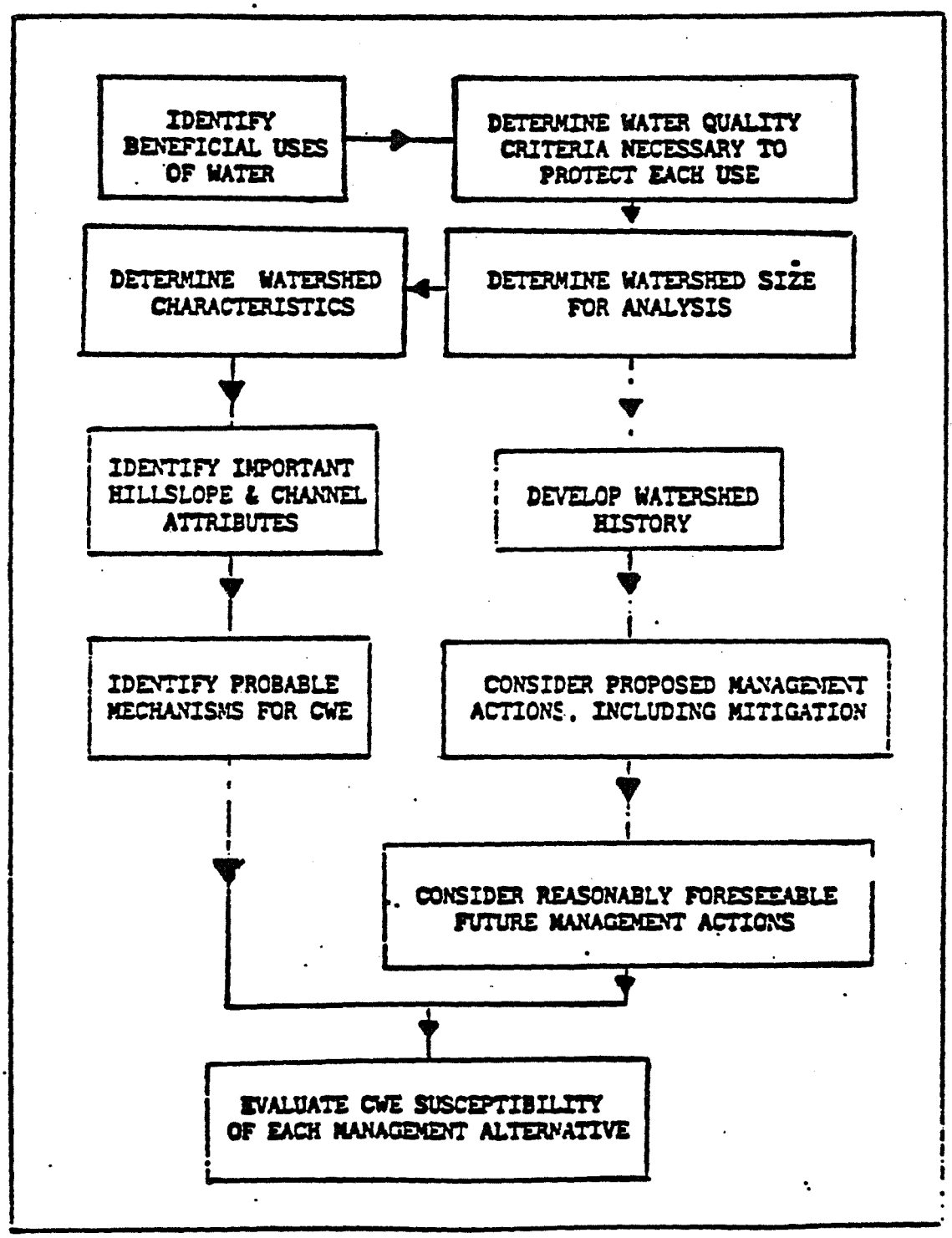
4. Determine level of watershed disturbance using normalized numerical coefficients by:
   a) developing watershed history.
   b) considering proposed activity.
   c) considering reasonably foreseeable future activities.

5. Evaluate CWE susceptibility by:
   a) using level of disturbance to watershed tolerance comparison as a screen to determine first cut of CWE risk.
   b) using air photo interpretation and field observations to assess watershed condition to refine CWE risk determination.

6. Documentation

National FS Library
USDA Forest Service
MAR 26 2011
240 W Prospect Rd
Fort Collins CO 80526

EXHIBIT 1


IDENTIFY BENEFICIAL USES OF WATER
DETERMINE WATER QUALITY CRITERIA NECESSARY TO PROTECT EACH USE
DETERMINE WATERSHED CHARACTERISTICS
DETERMINE WATERSHED SIZE FOR ANALYSIS
IDENTIFY IMPORTANT HILLSLOPE & CHANNEL ATTRIBUTES
DEVELOP WATERSHED HISTORY
IDENTIFY PROBABLE MECHANISMS FOR CWE
CONSIDER PROPOSED MANAGEMENT ACTIONS, INCLUDING MITIGATION
CONSIDER REASONABLY FORESEEABLE FUTURE MANAGEMENT ACTIONS
EVALUATE CWE SUSCEPTIBILITY OF EACH MANAGEMENT ALTERNATIVE

1. Beneficial Uses of Water

Beneficial uses of water are designated by the State of California for the large river basins on the Forest: Mokelumne River, South Fork American River, Middle Fork American River and the Cosumnes River. These beneficial uses are identified in the Water Quality Control Plan (Basin Plan) for the Central Valley Regional Water Quality Control Board (State of California, CVRWQCB, 1989). Beneficial uses specific to the smaller sub-watersheds are identified by water rights files, FERC project files, California Department of Water Resources, fisheries information and information in the Forest Land and Resource Management Plan.

The Basin Plan includes narrative water quality objectives and some quantitative standards for water quality parameters for protection of beneficial uses. These standards and objectives speak primarily to physical and chemical constituents, such as sediment, dissolved oxygen, and metals, within the water column.

A team of hydrologists and fisheries biologists developed criteria for protection of fish habitat. Habitat elements of concern include large woody debris, sediment/embeddedness and condition of the riparian zone.

2. Watershed Size

The Eldorado National Forest contains all or portions of the following Water Resource Council Hydrologic Units (USDA-FS, 1987b):

Watershed	Code				
Middle Fork American River	18	02	01	28	02
Rubicon River	18	02	01	28	03
South Fork American River	18	02	01	29	01
North Fork Mokelumne River	18	04	00	12	01
Cosumnes River	18	04	00	13	01

These large watersheds were subdivided into "planning" watersheds of 3,000 to 10,000 acres in size to meet the proposed State guidelines (see map of Eldorado NF watersheds). The watershed boundaries were delineated in cooperation and agreement with Michigan California Lumber Co and Georgia Pacific Corporation, two of the major private timber land owners within the Forest boundary. There are a few watersheds larger than 10,000 acres. Some reasons for the larger size are due to wilderness areas or its a logical boundary based on geomorphology. In addition, there are some watersheds less than 1,000 acres, such as Darlington Canyon and Little Light Canyon, which were study sites in the mid-1980's.

When determining what watershed size to use for CWE analysis, the planning watershed is used as the first level of examination to give a landscape level analysis. These planning watersheds may need to be further subdivided depending upon the number and location of proposed timber sale units and the geomorphology of the area. If only one or two units of a proposed timber sale are located within a watershed, a determination is made on whether to do one of the following:

- Do a complete ERA/TOC modeling procedure for that watershed,
- Analyze a smaller subwatershed
- Do field investigations of those units and nearby channels.

3. Natural Sensitivity and Watershed Tolerance

The Natural Sensitivity Index (NSI) is a quantitative description of watershed characteristics relating to important hillslope and channel attributes that contribute to mechanisms for CWE. The current process for determining the NSI is described in appendix A. The process is basically the same as described by Kuehn and Coboum (1989) with some modifications by an interdisciplinary team of hydrologists, soil scientists and geologists. Following the description of the NSI methodology is a copy of the spreadsheet used to calculate

MAP HERE (M1)

ELDORADO NATIONAL FOREST WATERSHEDS

Legend

8/24/93

Polygon	W.S.#	Watershed	Polygon	W.S.#	Watershed	Polygon	W.S.#	Watershed
1	4143	Headwaters Long Canyon	49	3233	Brush Creek	96	3736B	Hells Delight
3	5008	Middle Fork American River	50	3916	Forni Creek	97	2176	Upper Camp
4	4406	Upper Rubicon River	51	3403	Lower Silver Creek	98	3736A	Martin Creek
5	4133	North Fork Long Canyon	52	3906	Headwaters S. Fork American River	99	3651	Kirkwood Creek
6	5043	Chipmunk Creek	53	3525	Ice House Reservoir	100	2156	Big Pebble Canyon
7	4033	Elliott	54	3435	Jay Bird Canyon	102	3621	Martin Meadows
8	4123	South Fork Long Canyon	55	3415	Round Tent Canyon	103	2216	North Fork Cosumnes River
9	4336	Wentworth	56	3203	Slab Creek Reservoir	104	2206	Lower North Fork Cosumnes River
10	4346	Leon Lake	57	3126	One Eye Creek	105	3606	Sherman Canyon
11	4103	Lower Long Canyon	58	3311	Soldier Creek	106	3611	North Tragedy Creek
12	4113	Wallace Canyon	59	3325	Riverton	107	3661	Silver Lake
13	4043	Deer Creek	60	3305	Pacific House	108	2246	Van Horn Creek
14	4416	Desolation	61	3956	Sayles Canyon	109	2236	Upper North Fork Cosumnes River
15	5033	Brushy Canyon	62	3906	Kyburz	110	1401	Salt Springs Reservoir
16	4326	Gerle Creek	63	3355	Slide	111	2301	Lower Steely Fork Cosumnes River
17	4003	Ralston	64	3946	Strawberry Creek	112	1411	Blue Lakes
18	4316	Robbe	65	3936	Cody Creek	113	2226	Big Canyon
19	5023	Otter Creek	66	3226	Pollock	114	2326	Upper Steely Fork Cosumnes River
20	4306	Cold Springs	67	3116	Iowa Canyon	115	1331	Tragedy Creek
21	4013	Big Grizzly Canyon	68	3346	Mill Creek	116	2436	Dogtown Creek
22	4203	Blodgett	69	3706A	Middle Creek	117	2456	McKinney Creek
23	4023	Pigeon	70	3706	China Flat	118	2491	Anderson Canyon
24	3646	Basel Creek	71	3006	North Webber Creek	119	1311	Pedesta
25	4243	Lake Edson	72	3726	Packsaddle	120	1321	Upper Bear River
26	3666	Tells Creek	73	3926	Station Creek	121	2471	Cat Creek
27	5013	Georgetown Canyon	74	3336	Plum Creek	122	2316	Clear Creek
28	3143	Rock Creek	75	2116	Jenkinson Reservoir	123	1421	Cole Creek
29	3606	Little Silver Creek	76	3716	Beamville Creek	124	2481	Upper Middle Fork Cosumnes River
30	3606	Union Valley Reservoir	77	2126	Hazel Creek	125	2406	Lower Lower Middle Fork Cosumnes
31	3656	Barrett Creek	78	3756	Mule Canyon	126	2461	Middle Middle Fork Cosumnes
32	3133	Whaler Creek	79	2136	Sly Park Creek	127	2446	Middle Dry Creek
33	4223	Bacon Canyon	80	2106	Lower Camp Creek	128	2421	Lower Middle Fork Cosumnes
34	4213	Deep Canyon	81	3736A	Bark Shanty	129	1301	Bear River Reservoir
35	3166	Traverse Creek	82	3366	Alder Creek	130	2411	Soplago Creek
36	4233	Dark Canyon	83	3736	Owens Camp	131	1221	Lower Bear River
37	3153	Bear Creek	84	3736C	Bankers Tree	132	2501	Scott Creek
38	3636	Big Silver Creek	85	3631	Caples Creek	133	1121	East Panther Creek
39	3626	Willow	86	2006	Pleasant Valley	134	1111	West Panther Creek
40	3243	Pine Grande	87	3016	South Webber Creek	135	1011	Tiger Creek
41	3443	Orion Creek	88	3366	Alder Reservoir	136	1001	Antelope Creek
42	3976	Pyramid Creek	89	3396	North Creek	137	1211	Beaver Creek
43	3536	Wrights Lake	90	2146	Middle Camp Creek	138	1231	Calaveras Dome
44	3423	Sunset	91	3376	Little Light Canyon	139	1201	Mokelumne River
45	3616	Bosworth	92	3746	Girard Creek	140	1101	Devils Nose
46	3513	S. Fork Silver Creek	93	3641	Caples Lake			
47	3213	Deerview	94	2166	Darlington Canyon			
48	3103	Chili Bar Reservoir	95	3766	Fitch Rantz			

the area of rock outcrops, soils in hydrologic groups D and C, and the highly erosive soils. This information is from the list of soil map units within a watershed.

The NSI is used to set the watershed's Threshold of Concern (TOC). The TOC is an estimate of "the upper limit of watershed tolerance to externally applied factors such as climate and land use" (USDA-FS, 1987a). TOC's are set according to the following table:

NSI	Sensitivity	TOC
< 15	Very Low	18 - 20 % ERA
16 - 35	Low	16 - 18 % ERA
36 - 50	Moderate	14 - 16 % ERA
51 - 65	High	12 - 14 % ERA
> 65	Very High	10 - 12 % ERA

This scale is based on Kuehn and Coboum's NSI methodology and has not been updated for the current NSI process. As a result, these TOC's are probably conservative, considering the NSI's computed according to the current process are generally greater than those computed using Kuehn and Coboum's method. Watersheds are given a range for the TOC, which is further refined later in the process when field information is available.

4. Watershed Disturbance

A watershed disturbance history is compiled from timber sale records, maps, air photos and other records. All timber harvest and site preparation activity from 1960 is included in this list. Appendix B contains guidelines for compiling the watershed disturbance history. Other disturbance activities included in the history are roads, wildland fires, fuels treatments, silvicultural treatments, grazing, campgrounds, urban interface areas, and watershed improvement projects.

Normalized numerical coefficients are used to track overall land disturbance within the watershed. The "Equivalent Roaded Acre" or ERA is used as the standard. A road surface is considered to be the most extreme type of disturbance in terms of increasing or concentrating water flows and sediment production. A road is given an ERA coefficient of 1.0. Other types of disturbance are equated to a road surface by ERA coefficients reflecting their relative level of disturbance. For example, disturbance from a tractor clearcut is considered to be one-fourth that of a road surface and is given a coefficient of 0.25. ERA coefficients are decayed over time to reflect watershed recovery, i.e. a tractor clearcut is given a coefficient of 0.25 the first year after harvest and 0.15 ten years after harvest. After 30 years, the coefficient is very low, reflecting the residual impact of skid roads.

Appendix C contains the coefficients for roads, timber harvest, site prep and wildfires. Equations were fit to the coefficients developed by Kuehn and Coboum in order to automate calculation of percent ERA on a personal computer. The name of the program used to calculate percent ERA is called "ERODA". Appendix C contains Kuehn and Coboum's coefficients, the equations currently used in ERODA and a table with the ERODA coefficients computed from the equations. Coefficients less than zero are considered to be zero by ERODA. The exception is ripping roads and skid trails or sub-soiling units which are given negative coefficients because they benefit watershed condition.

An interdisciplinary team developed a process for including livestock grazing in the ERA model. This process is documented in Appendix D. A separate interdisciplinary team developed ERA coefficients for the urban interface areas. A County zoning map is used to categorize land by use. Groups of similar land use are given the same coefficient. These coefficients are listed in Appendix E.

To calculate the level of disturbance or "percent ERA" of a watershed, the acres of each activity is multiplied by the appropriate ERA coefficient to calculate the ERA for that activity. The ERA's for the various activities are added together and the total is divided by the watershed area to get the "percent ERA" for the watershed. In the case of watersheds that contain wilderness, the area of wilderness is subtracted from the watershed area before dividing. This is done to prevent "dilution" of the ERA from activities on the intensively managed land by the non-managed land.

Appendix F contains the summary table from ERODA where percent ERA is calculated. The top section of the page is the ERA from past activities and the bottom section is the ERA for current, proposed and reasonably foreseeable future activities on National Forest land. Reasonably foreseeable future activities on private land are assumed to occur as planned and are included in the top section of the page as part of past activities. This summary table does not break out public and private ownerships. There are other tables in the ERODA program, which are not included in this document, where each activity is listed and the ERA calculated.

5. Evaluate CWE Susceptibility

Once the above information is compiled, there are five components to evaluating CWE susceptibility (see flow chart on next page):

1. ERA/TOC Screen
2. Quality of information on watershed and channel condition
3. Watershed and channel condition
4. Additional evaluation
5. Project assessment and mitigations

ERA/TOC Screen. The first component is the ERA/TOC comparison screen. This screen is used to make an initial assessment of the risk of adverse CWE on beneficial uses ("risk level") and to determine the minimum quality of information required to make a confident determination of risk. The "current" percent ERA of the watershed is compared to the TOC which was determined from the NSI. In most cases, the lower end of the TOC range will be used for the comparison. The initial assessment of risk is as follows:

ERA < .5 TOC	Low Risk
.5 TOC < ERA < .8 TOC	Moderate Risk
.8 TOC < ERA < TOC	High Risk
ERA > TOC	Very High Risk

For example, a watershed with an NSI of 55 has a disturbance level from past activity of 8.2 percent ERA. In this case, the TOC range would be 12 to 14 percent ERA. The current level of disturbance falls between .5 and .8 of the lower end of the TOC range (6.0 to 9.6 percent ERA). The initial assessment of CWE risk would be a moderate risk.

Quality of information. The second component is the quality of information available on current watershed and stream channel condition. Use of good quality information increases the confidence in the analysis. There are five levels of information. The quality of the information increases down the list:

a. historic survey information, old aerial photography
b. analysis of recent (within 2 to 3 years) aerial photography
c. recent field observations of selected watershed areas (spot checks described in Appendix G)
d. recent watershed-wide survey and inventory (channel classification and WIN inventory, fish habitat relationship surveys)

e. Intensive process and activity based assessments such as "V**", "Residual Pool Volumes", macroinvertebrate studies, etc.

Each risk level has a standard for what is the minimum level of information required to be considered good. As the risk indicated by the ERA/TOC comparison increases, the level of information required also increases. What is considered good quality for the low risk level is poor for the moderate risk level, and so on up the line. For example, for a watershed with a moderate risk such as the one in the previous example, the minimum level of information required to make an adequate assessment is available historic survey information, riparian condition from recent air photos and recent field observations of selected watershed areas. An assessment based solely upon historic information and/or air photo interpretation, while adequate for a watershed with low risk, would be considered poor for a watershed in the moderate risk level.

Watershed and stream channel condition. The third component is the condition of the watershed and stream channels as determined from the available information. If the quality of information is good for that risk level, the condition of the watershed is determined to be either good or poor. If the quality of the information is poor, it is possible that the current condition of the watershed is good, poor or unknown.

The condition of the watershed and the quality of the information used to make that assessment is used to refine the risk level. In the above example, if the quality of the information is good and it shows that the watershed is in poor condition, the risk of CWE could be considered to be high rather than the moderate indicated by the initial ERA/TOC comparison.

Additional evaluation. The fourth component is additional evaluation of watershed condition. If the information available indicates the condition of the watershed is poor or unknown, or if the risk based on the initial screen is high or very high, a recommendation can be made to do additional evaluation of watershed condition to increase the confidence in the CWE analysis. This additional evaluation would be to obtain the quality of information necessary for that risk level if the current information is poor or the next higher risk level if the current information is good. Using the same example as above, the watershed has a moderate risk level, the quality of information is good (historic data, recent air photos and field observations of selected areas), but the condition is poor, additional evaluation could be recommended. The additional evaluation would be a complete watershed-wide survey and inventory. If the quality of current information is poor (only historic data and recent air photos), the recommended additional evaluation would be field observations in specific selected watershed areas. In the case of watersheds over TOC with good quality information, the additional evaluation step is skipped because watershed analysis would be pretty much complete. The next recommendation could be for an in-channel monitoring plan (part of the Best Management Practices Evaluation Program) incorporated into the project.

Project assessment and mitigation. The final component in evaluating CWE susceptibility is to analyze the proposed project and determine mitigations necessary to minimize the risk of adverse CWE. During project assessment, the ERA of the watershed is updated to include the proposed activity and any reasonably foreseeable future activities on National Forest and private land. The new ERA is again compared to the TOC of the watershed do determine if the proposed project would increase the risk of CWE in the watershed.

In general, there are four levels of mitigations that could be recommended which correspond to the risk of CWE. These are as follows:

Risk Level	Possible Mitigations
Low Risk	Forest LMP Standards and Guidelines Best Management Practices R-5 Draft Soil Quality Standards
Moderate Risk	Widening SMZ areas Ripping skid trails

	Subsoiling units
High Risk	Change from tractor yarding to suspended yarding Obliterating roads and landings Watershed and stream channel improvements
Very High Risk	Defer project in space or time Recommend Environmental Impact Statement

Implementation of Forest LMP standard and guidelines, BMPs and Soil Quality standards are required for all projects but are sufficient, in most cases, to prevent CWE in watersheds with a low risk. As the risk increases, the mitigations are additive. For example, recommended mitigations for a watershed with a moderate risk could be ripping skid trails and landings, or wider SMZ in addition to implementation of LMP standards and guidelines, BMPs and Soil Quality Standards. The specific recommendations are determined by site specific analysis during project level planning and may not be applicable in all situations. The possible mitigations listed above are just examples of the type and intensity of mitigations that could be recommended for each risk level. For example, an Environmental Impact Statement may not be necessary just because the watershed is over the TOC or has a very high risk of CWE, it depends on the situation and anticipated effects of the proposed project.

6. Documentation

For each watershed analyzed, a base watershed report is written summarizing the analysis. This base report includes a description of the watershed, beneficial uses, natural sensitivity and land disturbance history. The ERA analysis in the base report includes all past disturbance in the watershed on private and National Forest land, but not proposed or reasonably foreseeable future activity. The base report discusses the risk of CWE for the current situation and makes recommendations regarding future activities in the watershed.

A supplement to the base report is written for each proposed project. The supplement will update the analysis in the base report to include the effects of the proposed project and any reasonably foreseeable future activities on private and National Forest land. The supplement will discuss effects of the proposed project and make recommendations for mitigations to minimize the risk of CWE during project implementation.

INTERDISCIPLINARY TEAM MEMBERS

Name	Discipline	Forest
Joan Carlson	Hydrology	Eldorado
Christine Christiansen	Hydrology	Eldorado
Anne Boyd	Geology	Eldorado
Ralph Johnson	Geology	Eldorado
Robert Gecy	Hydrology	Eldorado
Chuck Mitchell	Soil Science	Eldorado
Skip Barndt	Soil Science	Lolo
George Elliott	Fish Biology	Eldorado
Mary Kay Buck	Fish Biology	Sierra
Robbie Van de Water	Hydrology	Klamath
Ken Roby	Hydrology	PSW Station
Alan Somers	Forestry	Eldorado
Diana Brink	Range Conservation	Eldorado
Wayne Holmstrom	Forestry	Eldorado
Terry Tenley	Programming/Forestry	Eldorado
Hal Fiore	Hydrology	Eldorado
Kris Ivarson	Hydrology	Eldorado

REFERENCES

Applied Earth Sciences. 1985. Geologic Overview, Eldorado National Forest.

Carlson, J.Y. and C. Christiansen. 1993. Draft Eldorado National Forest CWE Analysis Process.

Kuehn, M.H. and J. Coboum. 1989. Summary report for the 1988 cumulative watershed effects analyses on the Eldorado National Forest.

Mitchell, C.R. and K.J. Silverman. 1984. Soil Resource Inventory of the Eldorado National Forest Area, California.

Pfankuch, D.J. 1978. Stream Reach Inventory and Channel Stability Evaluation, USDA Forest Service, Northern Region.

Rosgen, D.L. 1988. A Stream Classification System. In K.M. Mute et al, eds, Symp. on Restoration, Creationand Management of Wetland and Riparian Ecosystems Ins the American West, pp 163-179.

State of California, Central Valley Regional Water Quality Control Board, 1989. The Water Quality Control Plan for the Central Valley Regional Water Quality Control Board. Second Edition. Adopted 31 March, 1989.

USDA Forest Service (Pacific Southwest Region). 1987a. Cumulative Off-Site Watershed Effects Analysis, Chapter 20, R-5 FSH 2509.22 Soil and Water Conservation Handbook.

USDA Forest Service (Pacific Southwest Region). 1987b. Forest Watershed Coding, Chapter 2, R-5 FSH 2509.24 National Forest System Watershed Codes Handbook.

USDA Forest Service (Pacific Southwest Region). 1993. Draft Soil Quality Standards, Supplement to Chapter 2, R5 FSH 2509.18 Soil Management Handbook.

USDA Soil Conservation Service. 1965. Soil Survey, Amador, California.

USDA Soil Conservation Service. 1974. Soil Survey, El Dorado Area, California.

APPENDICES

Appendix A	Natural Sensitivity Index
Appendix B	Compiling Watershed History
Appendix C	ERA Coefficients
Appendix D	Grazing
Appendix E	Urban Interface
Appendix F	ERODA Summary Sheet
Appendix G	Stream Survey Process

APPENDIX A - NATURAL SENSITIVITY INDEX

NSI.XLS

CWE Natural Sensitivity Index

Table 1

Watershed:
Total Acreage: 0
USFS Acres: 0
Private Acres: 0

Date:
Prep. by:

NSI Attributes:	Total Acres	x	Index Factor	=	Index Total
I. Attributes Affecting Runoff Processes					
A. Horton Overland Flow					
1. Rock Outcrop	0		1.0		0.0
2. Hydrologic Soil Group D	0		0.8		0.0
3. Hydrologic Soil Group C	0		0.4		0.0
B. Saturation Overland Flow					
1. Wet Meadows	0		1.0		0.0
2. Ponds	0		1.0		0.0
3. Streamside Management Zones	0		1.0		0.0
II. Attributes Affecting Sediment Delivery					
C. Erosion From Highly Erosive Soils					
1. Soils Prone to Gully Erosion	0		1.0		0.0
2. Soils With a Very High EHR (includes altered/eroded phases)	0		0.5		0.0
B. Erosion From mass wasting					
1. All Active forms of mass wasting	0		8.0		0.0
2. Inner Gorge	0		2.0		0.0
C. Channel Erosion					
1. Aggradation	0		1.0		0.0
2. Degradation	0		1.0		0.0
3. Lateral Scour and Bank Erosion	0		4.0		0.0

Subtotal for Natural Sensitivity Attributes:	0

III. Drainage Basin and Channel Morphology Affecting Sediment Routing Processes		Index Factor Low	Mod	High	Extr	
A. Relief Ratio (ft/ft)	0.00	0.9	1.0	1.1	1.2	0.90
B. Drainage Density :	0.00	0.9	1.0	1.1	1.2	0.90
C. Precipitation Regime (snow, rain, rain/snow)	r	0.8	1.0	1.2		1.00
D. Channel classifications:		0.9	1.0	1.1	1.2	
1. Rosgen: %Length by Sensitivity		0%	0%	0%	0%	
Index Value:		0.00	0.00	0.00	0.00	0.00
2. Pfankuch: %Length by Sensitivity		0%	0%	0%	0%	
Index Value:		0.00	0.00	0.00	0.00	0.00

Product for Channel Morphology Attributes:	0.00

Weighted Percentage of Watershed Classified Sensitive: 0 / 0 = 0

Natural Sensitivity Index:	0.00	x	0	=	0
Empirically Derived	Threshold of Concern (TOC) =				

NSI METHODOLOGY
Prepared 5/10/93 by B.Gecy

The Natural Sensitivity Index (NSI) is an estimate of the response of a watershed to current and future disturbance. The NSI is determined by quantifying information about soils, geology, climate, vegetation, channel morphology, hydrology, and physically and biologically sensitive land units as directed by the USFS Region 5 Soil and Water Conservation Handbook (Sec. 22.23). Weighting factors are assigned to each attribute according to its importance in hydrologic processes which affect water quality. A weighted percentage of the area of the watershed which is classified as sensitive is arrived at by summing an indexed total of those attributes which affect runoff processes and those which affect sediment delivery processes. This total is then multiplied by the product of the weighting factors to arrive at the Natural Sensitivity Index or NSI. The worksheet used to determine the NSI follows this report. The attributes that are considered in determining the NSI are described below.

I. ATTRIBUTES

Soils

Watershed areas, in acres, have been determined by by entering plots of watershed boundaries into the Geographic Information Systems (GIS)data base. Soils information for each watershed is plotted on a mylar overlay or 1:24,000 topographic base map, or both. A soils index is created which sums the cumulative areas of different soils groups, land ownership, and lakes and ponds within each watershed. Areas are determined by planimeter from the overlay or topographic base. In the future this information will be available through GIS. The planimetered data are normalized to the GIS-determined acres for consistency. Information on soil types is obtained from Soil Conservation Service surveys for El Dorado and Amador counties and from Soil Resource Inventories of the Eldorado and adjacent (Tahoe, Stanislaus) National Forests. The soils information is used to determine areas of rock outcrop, soil groups that are less permeable and therefore promote greater surface runoff (Hydrologic Soil Groups C and D), soils with very high Erosion Hazard Ratings (EHR), and gully prone soils. These different surface types are given an index factor which weights their relative contribution to surface runoff and sediment delivery within the watershed.

Streamside Management Zones

The length of stream channels by stream class is measured by planimeter for Class I, II, and III streams. The area of Streamside Management Zones (SMZ) within each watershed is calculated by multiplying the length of stream channel within each class by the minimum width of SMZ for each stream class and then converting to acres. The SMZ acres for each stream class are summed to produce a total for the watershed. This is used as an estmate of the area in which saturation overland flow processes occur. At present, SMZ acres for

Class IV stream channels are not included in the NSI calculation. The minimum SMZ width by stream class is as follows:

Stream Class	SMZ width	
I	200 feet	(for one side of stream only)
II	~~150~~ 100 feet	"
III	100 feet	"
IV	50 feet	"

Wet Meadows and Ponds

Areas of permanent and ephemeral ponds and wet meadows are included in the NSI if their presence can be determined from the 1:24,000 topographic base. Generally, the surface area of these features is small and they have not been included in the NSI for most watersheds, if they are present at all. Detailed aerial photograph interpretation, field surveys, or both are required for a more accurate determination of the extent of these features.

Geology

Inner Gorge

The presence of valley inner gorge and active landslides was determined from 1:12,000 or 1:24,000 scale aerial photos. The valley inner gorge generally consists of the lower-most slopes within a stream canyon where hill slope gradients exceed 65%, and where a distinct break in slope gradient separates upper slopes from the inner gorge. The inner gorge is the result of rapid stream down cutting and undercutting of slopes adjacent to the stream. Landsliding, rockfall, rock slides, slope wash, soil creep and ravel are all active processes within the inner gorge. The development of inner gorge is a function of stream power (the ability of a stream to downcut its channel) and geology. With few exceptions, inner gorges occur in mid- to lower elevations where the majority of precipitation falls as rain, streams are larger and stream power is highest. In the Sierra Nevada, inner gorges develop mainly in granitic and metasedimentary rocks and are rare in volcanic rocks. On the Eldorado National Forest, the largest areas of inner gorge are developed in metasedimentary rocks. As a percentage of watershed area, inner gorges are slightly more prevalent in metasedimentary rocks than in granitic rocks. The orientation of internal structures in rocks such as faults, joints, fractures, and foliation combined with other features such as the degree of weathering, rock hardness, particle or grain size, etc., all are factors in determining the development of inner gorge.

Inner gorges are mapped on a topographic base (1:24,000) from analysis of 1:12,000 or 1:24,000 air photos in conjunction with map elevation contours. Map contour spacing

provides an estimate of the slope gradient and helps identify the upslope limit of the inner gorge. Stream channel and flood plain acreage is included within the inner gorge except where the inner gorge occurs only on one side of the stream. The extra acreage is approximately balanced by the area lost where the inner gorge is too narrow to be mapped separately. The area of inner gorge is measured from the topographic base map using a planimeter. Any area of active landslides within the inner gorge are mapped separately and subtracted from the area of inner gorge.

Landslides

Active or potential landslides are those areas which exhibit evidence of recent activity (within approximately the last 100 years) or exhibit a high potential for future activity if disturbed. This may include landslides, debris slides, avalanches, or earth flows. Areas of active earth movement may be identified by any of the following characteristics: bare, disrupted ground; clearly defined scarps and benches; disturbance of vegetation patterns; hummocky ground. Potential slide areas are identified as areas of past activity where the presence of such characteristics as springs and wet areas (indicating saturated ground), over-steepened scarps, or undercut or over-steepened toe slopes indicate a high probability of future activity.

Areas of active and potential slides are mapped on a 1:24,000 topographic base after interpretation of 1:12,000 or 1:24,000 air photos. The ability to determine the presence of small debris slides or debris torrents is limited by the scale of the photos used and by the presence of vegetation which may obscure smaller stream channels. Small-scale features are typically mapped only during field surveys. Slide areas mapped during field investigations are included where this information is available. The area of individual slides is measured from the map using a planimeter.

Channel Erosion

Processes that occur in the stream channel that determine the amount of sediment carried by the stream are *aggradation*, *degradation*, and *lateral scour* or *bank erosion*. Aggradation is the buildup of excess sediment within the stream channel. Degradation refers to active downcutting of the stream channel through older deposits and is usually associated with areas of aggradation. Sites of lateral scour and bank erosion are areas in which the channel is actively migrating laterally or where increases in current velocity are removing sediment from the cahnnel bottom. The extent of these features is best determined in the field during stream surveys. At present detailed surveys have been completed for only 9 watersheds on the forest. Air photo interpretation has not yet been used because of the time needed and the limited usefulness of the method. For purposes of determining the NSI, the minimum SMZ width is selected as the width of the affected area where attributes of channel erosion are present.

II. WEIGHTING FACTORS

Geomorphic characteristics of a watershed are assigned an index factor which is designed to reflect the efficiency of the basin in affecting sediment routing processes. The product of these factors is multiplied by the weighted percentage of the watershed classified as sensitive to calculate the NSI.

Drainage Density

Drainage density is commonly viewed as an indicator of the relationship between climate, vegetation, and the resistance of rock and soil to erosion. In general, the density of a drainage network is highest where rocks are weaker and less resistant to erosion, soils are more permeable, or where precipitation is highest. In watersheds on the Eldorado National Forest, drainage density is highest in metamorphic rocks and lowest in volcanic and granitic rocks. This reflects on the relative strength, resistance to erosion and geographic distribution of the different rock types. Metasedimentary rocks are usually layered, foliated, and more highly fractured than other rocks. This exposes more surface area to air and water and increases the rate of weathering and erosion. Metasedimentary rocks also tend to occur at lower elevations where rivers and streams are larger and more of the annual precipitation occurs as rain, resulting in more and faster surface runoff. The majority of granitic rocks occur at higher elevations where precipitation falls mainly as snow and surface runoff has less erosive power. The weathering rate of granitic rocks is mostly controlled by the spacing of joints which form in response to regional stresses or the relief of pressure as overlying rocks are eroded away. In general, granites are not as fractured as metasedimentary rocks and joints are less frequent. The lower drainage densities in watersheds dominated by granitic rocks is an indication that these rocks are eroding at a slower rate. The low drainage density in areas composed of volcanic rocks is more directly reflects the distribution of the volcanic rocks on ridgetops where drainages are less well developed, and to a lesser extent their resistance to weathering and erosion. Some of the volcanic rocks are more permeable, which allows higher water infiltration, and lessens the need for a more developed drainage network to carry surface runoff.

Drainage density is normally represented as the unit length of stream channels per unit area and is expressed in mi/mi^2 or km/km^2. In our calculations, an approximation of the drainage density is determined by counting the number of first order tributaries within a basin and dividing by the area (in acres) of the basin, giving the number of first order tributaries (#F.O.T.) per acre. This is slightly different than the normal procedure of measuring the cumulative length of stream channels within the basin and dividing by the area. The numbers produced by our method are of a different magnitude, but are roughly similar in distribution to the method that is normally used. Index factors are assigned to different values of drainage density as follows:

Drainage Density	Index Factor	Sensitivity
< .02	0.9	(Low)
.021 - .030	1.0	(Moderate)
.031 - .040	1.1	(High)
> .041	1.2	(Extreme)

Relief Ratio

The relief ratio is defined as the total basin relief divided by the length of the basin. The highest and lowest points in the basin are selected from a 1:24,000 topographic map of the basin. In general, these points are rounded to the nearest 5 feet unless an obvious benchmark or landmark is used. The length of the basin is taken as the length of a line which approximately parallels the main channel. The measured length of the line may vary depending on how straight the stream channel is. Line lengths are measured to the nearest 1/8 inch resulting in basin lengths rounded to the nearest 250 feet. Values for the relief ratio are assigned index factors as follows:

Relief Ratio	Index Factor	Sensitivity
< .070	0.9	(Low)
.071 - .100	1.0	(Moderate)
.101 - .130	1.1	(High)
> .131	1.2	(Extreme)

Precipitation Regime

An index factor is given for a watershed depending on how it falls into one of three broad climatic zones. At elevations less than 3,500 feet, the majority of precipitation falls as rain. Between 3,500 and 6,000 feet, precipitation may fall as either rain or snow. Above 6,000 feet precipitation falls mainly as snow. These three zones correspond to increasing mean precipitation (45 inches, 55 inches, and 62 inches, respectively) with gain in elevation. The precipitation regime for a watershed is chosen as the zone in which the greatest area of the watershed is contained. However, in the Sierra forests, watershed sensitivity is believed to be highest in the rain on snow zone and lowest in the snow zone. This is reflected in the following index factors:

Precipitation Regime	Index Factor	Sensitivity
snow	0.8	(Low)
rain	1.0	(Moderate)
rain/snow	1.2	(High)

Channel Classification

The Rosgen (1985) stream classification system and Pfankuch (1978) channel condition ratings are used in the course of detailed field surveys of individual streams. Each stream reach is assigned a rating under each classification during the survey. The Rosgen and Pfankuch ratings are grouped to reflect their relative sensitivities to disturbance and then index factors are assigned as follows:

Rosgen Channel Type	Index Factor	Sensitivity
A1, A2, B1, C1, D1, F1	0.9	(Low)
B2, B3, C2, C3, D2, F2, F3	1.0	(Moderate)
A3, B4, B5, C4, C5, D3	1.1	(High)
A4, A5, A6, B6, C6, D4, D5,... ...D6, F5, F6	1.2	(Extreme)

Pfankuch Rating	Index Factor	Sensitivity
0 - 38 (Excellent)	0.9	(Low)
39-64 (High Good - Medium Good)	1.0	(Moderate)
65-89 (Low Good - High Fair)	1.1	(High)
>90 (M.Fair - L.Fair - Poor)	1.2	(Extreme)

After stream channel ratings are compiled, the percentage of channel length within each category is multiplied by its index factor, and the resulting values are totaled to arrive at an index for both the Rosgen and Pfankuch ratings. For example:

Sensitivity			Rosgen Rating %		Pfankuch Rating %	
Extreme	1.2	x	30	0.360	25	0.300
High	1.1	x	30	0.330	25	0.275
Moderate	1.0	x	20	0.200	25	0.250
Low	0.9	x	20	0.180	25	0.225
			SUM=	1.070	SUM=	1.050

For watersheds in which stream surveys have been completed, the percentage of channel length which falls in each category is entered on the NSI tally sheet. For watersheds that

have not been surveyed, assumed values of 100% Moderate are used for both the Rosgen and Pfankuch rating factors, resulting in an index factor of 1.0 for both ratings.

Index values for drainage density, relief ratio, precipitation regime, and channel classification are multiplied together and the product is used as an overall index factor for the watershed. This product is multiplied by the weighted percentage of the watershed classified to calculate the NSI score.

References cited:

Pfankuch, D.G. 1978. Stream Reach Inventory and Channel Stability Evaluation, USDA Forest Service, Northern Region.

Rosgen, D.L. 1985. A Stream Classification System. In: Mute, K.M., et al, eds., Symposium on Restoration, Creational Management of Wetland and Riparian Ecosystems in the American West, pp 163-179

Watershed / (#):				Date:		
GIS Normalized	Total Acres					
Rock Outcrop	#DIV/0!		Planimetered Acres:			
Hydr. Soil Group D	#DIV/0!		GIS Acres:			
Hydr. Soil Group C	#DIV/0!		Conversion Factor:		#DIV/0!	
Gully Prone	#DIV/0!					
Very High EHR	#DIV/0!					
			Enter planimeter acres below only!			

Soil Type	Parent Rock	Acres	Acres Hydro C	Acres Hydro D	Acres VHigh EHR	Acres Gully Prone	Acres Rock Outcrop
101	V	100	10				
102	V	100		40	25		
103	AV	100		100			
104	G	100					
106	G	100				100	
107	G	100	20			100	
108	G	100	20			100	
109	G	100			40	100	
110	V	100	20				
111	V	100					
112	V	100	15				
113	V	100		15			
114	V	100		15			
115	V	100		20			
116	V	100	65				
117	V	100	60				
118	V	100	70				
119	V	100	100				
120	G	100		30			
122	G	100					
123	G	100					
125	AV	100	75				
126	G	100					
127	G	100		20			
128	G	100					
129	G	100					
130	MS	100					
131	MS	100	15		40		
132	MS	100	35				
133	MS	100	40				
134	MS	100					
135	MS	100	25				
136	MS	100					
137	MS	100	20				
138	MS	100	20				
139	MS	100	30				

140	MS	100	55				
141	V	100					
142	G	100				100	
143	G	100				100	
144	G	100				100	
145	G	100				100	
146	G	100				100	
147	G	100				100	
148	G	100				100	
149	G	100				100	
150	MS	100					
151	MS	100					
152	MS	100					
153	MS	100					
154	MS	100	35	25			
155	MS	100	50				
156	G	100	15			85	
157	G	100	10			55	
158	G	100	10			60	
159	V	100		70			
160	V	100	20	45			
161	V	100		100			
162	V	100	10	55			
163	V	100		55	55		
164	V	100	20	40	40		40
165	G	100		20		100	
166	MS	100		20		100	
167	MS	100	100				
168	MS	100	100				
169	MS	100	60				
170	MS	100	70				
172	MS	100	60	40			
173	MS	100	20	50			
174	MS	100		65	65		35
175	V	100	20				
176	V	100					
177	V	100		40			
178	V	100		45			
179	V	100		10			25
180	MS	100	25				
181	MS	100	25				
182	MS	100	100				
183	MS	100	75				
184	MS	100	100				
185	MS	100	40	30	30		20
186	MS	100	70				
187	G	100					
188	G	100					
189	G	100				30	

190	G	100		15		30	
192	G	100				100	
193	G	100				100	
194	G	100				50	
195	G	100				50	25
196	PITS	100					
197	AV	100			100		
198	MM	100					100
199	G	100		20			50
200	G	100	20				65
201	G	100		15			
202	G	100	25				
203	G	100		30			
204	MS	100	35	30			20
205	G	100	100				
206	G	100	40	15			20
207	G	100	50				
208	G	100	35				20
209	G	100	50				20
210	G	100	10	30			
211	V	100		20			
212	V	100		20			
213	V	100	10	25			
214	V	100		40			
215	V	100					
216	V	100					
217	V	100	10				
218	V	100					
219	V	100	20				
220	G	100		15			
221	G	100	15				
222	G	100	25				
223	G	100					
224	G	100					30
		100	Stanislaus N.F. Soils				
116-S	G	100					
117-S	G	100					
120-S	G	100		11.66667			
121-S	G	100		11.66667	25		
135-S	G	100	10		40	100	
137-S	V	100	30	5			5
159-S	MS	100	50	10			
160-S	MS	100	55				
169-S	G	100		40	80		10
170-S	G	100		46.66667	73.3333333		20
172-S	G	100		48.33333	83.3333333	100	
175-S	V	100		40			20
179-S	V	100		10			10

180-S	V	100		10			10
183-S	-	100					85
192-S	G	100	10		10	100	
193-S	V	100		6.25	6.25		6.25
194-S	G	100			10		
196-S	V	100		10			10
	S.C.S. Soils fo	100					
AcF	G	100			40		60
AcC	G	100	95			95	5
AdD	G	100	85			85	15
AdE	G	100	85		85	85	15
AfB	V	100					
AfB2	V	100					
AfC	V	100					
AfC2	V	100					
AfD	V	100					
AgD	V	100					
AkC	MM	100		95			5
AlD	MS	100		100			
AmD	MM	100		85			15
AnB	MM	100		95			5
AoB	MM	100		100			
AsC	G	100				92.5	7.5
AtD	MS	100					15
AtE-E	G	100			100	100	
AtE-A	MS	100			100		
AuD	G	100	100				
AwD	MS	100		100			
AyF	MS	100		62.5	62.5		37.5
AxD	MS	100		85			15
AxE	MS	100		100			
AzE	MS	100		100			
BkF	MM	100	100				
BkD	MM	100	100				
BkE	MM	100	55				15
BpC	MM	100	55				
BpD	MM	100	55				
BrC	MM	100	55				
BrE	MM	100	55				15
CcE-A	G	100					
CcE-E	G	100	85				15
CcF	G	100	100		100	100	
ChE	G	100	85				15
ClD	V	100					
ClE	V	100					
CmB	V	100					
CmC	V	100					
CmD	V	100					
CoC	V	100					

CoE-A	V	100			100		
CoE-E	V	100					
CrE	V	100	100				
DeE	MM	100		85			15
DfB	G	100	100				
DfC	G	100	100				
DfD	G	100	100				
DgE	G	100	100				15
DrE	G	100					
GuF	gullied	100			100		
HfF-A	G	100			100	100	
HgC	G	100				95	5
HgD	G	100				95	5
HhC	G	100				92.5	7.5
HkE	G	100			85	85	15
HkF	G	100				85	15
HsE	AV	100					
HtE	G	100	85		85	85	15
ImE-E	V	100		67			33
IsE-A	V	100		100	100		
JmE-A	MM	100			100		
JoE-A	MS	100			87.5		12.5
JoF-A	MS	100			100		
JrC	MS	100					
JrD	MS	100					
JsE	MS	100					15
JtC	MS	100					
JtD	MS	100					
JtE	MS	100					
JuE	MS	100					15
JuF	MS	100					15
JvD	MS	100	35				
MaD	MS	100	95				5
MbE	MS	100	85				15
MbF	MS	100	100				
McE	MS	100	100				
McF	MS	100	100				
MfF	MS	100		85			15
MhE	V	100	100				
MlC	MM	100					
MkE	V	100			100		
MkF	V	100			100		
MmE	V	100			100		
MmF	MM	100					70
MO	AV	100					
MrC	G	100	100				
MrD	G	100	100				
MsC	G	100	92.5			92.5	7.5
MtE	G	100	85			85	15

MuE	G	100			80	80	20
MvF	G	100			85	85	15
PeD	G	100	100				
PgB	AV	100	100				
PrD	placer	100					
Rk		100		100			
RO		100					100
SoF	MM	100		30			70
ScC	G	100					7.5
SdE	G	100					15
SdF	G	100			85	85	15
SgC	G	100					7.5
ShD	G	100					15
ShE	G	100			85		15
SkC	MS	100					
SkD	MS	100					
SkE	MS	100					
SnE	MM	100					
SoE	MS	100					
SrE	MS	100					15
SrF	MS	100					15
SsC	MS	100					15
SsD	MS	100					
SsE	MS	100					
SuC	MM	100	100				
SuD	MM	100	100				
SwD	MM	100	85				15
TaD	tailings	100					
TbE	MS	100					
TcE	V	100			100		
WaB	AV	100					
WcE	V	100			100		
WcD	V	100			100		
WhE	MS	100		98			2
		26700	6502.5	2962.08	3002.91667	3882.5	1553.75

APPENDIX B - COMPILING WATERSHED HISTORY

Guidelines for compiling watershed disturbance data

1. Watershed size
   a. use "new" watersheds. We got together with Mich-Cal and CP and divided the watersheds to meet the size required by the State in the Forest Practice Rules. These watershed boundaries are already in our GIS system.

2. Maps
   a. mapping is recommended in order to avoid double-counting acres of land re-entered for harvest, especially overstory removal and selection/salvage operations and to become a part of the CWE analysis data base for that watershed.
   b. maps should be on stable mylar base at 1:24000 scale
   c. have separate overlays for various activities, ie, a road overlay, a harvest overlay, a site prep overlay, etc. or if a heavily disturbed watershed, an overlay for activities in periods of years ie 1980-1984, 1985-1990 etc.
   d. have some way to tie the info on the map to the list of disturbances through labeling, color coding...

3. Roads
   a. length and width of all roads (public and private, system, non-system, abandoned and ripped or obliterated) and trails including cut slopes is needed to determine acres of road.
   b. list by road name or number and design and or maintenance class if known
   c. measurement can be in feet, chains or miles, just so units are identified
   d. please do not rely on USGS quad sheets as all roads are not included
   e. ERA coeffient can be increased for road segments with poor drainage or diversion potential, so include that info if known.

4. Landings
   a. it would be best if you determine the actual number of landings since landings get re-used, if not the rule of thumb is: 1 landing for each 20 acres of harvested land, 1/4 acre for tractor/cable landings and 1/2 acre for helicopter.
   b. include ripped and obliterated landings, labeled as such.

5. Harvest history
   a. summarize activity by sale name, Rx and year. For example:

Name	Year	Activity	Method	Acres
Clear	86	CC	TR	6
Elkins	87	OSR	TR	47
Elkins	86	CC	TR	75

   b. include all activities to 1960, clearcuts, shelterwood, selection, salvage, thinning, seed tree, overstory removal, tractor, cable and helicopter...
   c. use mapping to eliminate double-counting, example if 100 acres had been OSRed in 1970, half of it OSRed again in 1975 and then two 15 acre clearcuts in that same half in 1980, the tally would be:

Sale 1	70	OSR	TR	50
Sale 2	75	OSR	TR	20
Sale 3	80	CC	TR	30

the total 100 acres is accounted for, not 180 (100+50+30) acres
d. for the large salvage sales, use the landings that were actually used and the approximate acres affected per landing rather than the entire sale area acreage, summarize by sale name, Rx and year.
e. if older activities do not have sale names, summarize by year

6. Site prep and release
a. summarize activity by sale name, Rx and year. For example:

Clear	88	P&B	TR	77
Clear	86	P&B	Hand	6
Elkins	88	BB		9

b. include all activities to 1960, mechanized and non mechanized
c. ripped/obliterated skid trails are important because get a negative coefficient. list the acres of the units that this activity occurred, not the actual acres of skid trail ripped.
d. include herbicide applications in last 2 years (1991 and 1992)
e. include hand grubbing activities in last three years (1990, 1991 and 1992)

7. Other disturbances
a. I've asked Fire staff in the SO for a fire history map of the Forest
b. we will include campground areas and other facilities by computing an assumed percentage of disturbance per acre of facility area.
c. we will not concern ourselves with grazing or mining at this time
d. for watersheds in the urban interface, we will develop a coefficient for those types of land based on photo review of the amount of disturbance.

8. Reasonably foreseeable future activity
a. list any activity expected to occur within the next 5 years - sales on the five year plan, herbicide units in existing EAs that haven't been treated yet, salvage under contract not yet cut, anticipated TSI activity etc. Need the Rx, year and acres.

9. This particular timber sale
a. Need to know, as a minimum, what the chosen alternative is for each of these old sales we are updating--Rx, acres and anticipated year of implementation.

10. Coefficients
a. We will be using the power functions derived by Terry Tenley to determine ERA coefficients. Basically, he fitted power functions to the coefficient chart made by Mike Kuehn in order to get the computer to interpolate for years not listed in the table. The fit is not exact, but I am satisfied with it. My goal is to eventually get this process semi-automated and Terry's program is a good start. His program, however, still has some bugs in it so I probably won't be using it, but using the equations will help us to be consistent in the future when the program is up and running.

APPENDIX C - ERA COEFFICIENTS

Table 2. ERA COEFFICIENTS (Kuehn, 1988)

Activity or Impact	Years Since Impact 1	2	5	10	20	50
I. TRANSPORTATION SYSTEM						
A. System & Non-system Roads & Landings						
1. good drainage	1.0	1.0	1.0	1.0	1.0	1.0
2. poor drainage	1.5	(fixing rd drng problems associated w/				
3 diversion potential	2.0	ditches, culv, etc; coefs return to 1.0)				
B. Abandoned Roads & Lndgs	1.0	.9	.9	.8	.8	.8
C. Trails (recreational)	1.0	1.0	1.0	1.0	1.0	1.0
D. Ripped & Oblit. Rd/Lndgs.	.4	.3	.3	.2	.1	.1
	-0.6	-0.7				
II. SILVICULTURAL SYSTEM						
A. Tractor (includes impact due to skid trails)						
1. Clearcut & Seed tree	.25	.24	.20	.15	.10	.08
2. Shelterwood	.22	.20	.15	.10	.10	.08
3. Overstory Removal	.20	.16	.12	.10	.10	.08
4. Sanitation/Salvage	.15	.10	.08	.05	.05	.04
5. Selection/Thinning	.15	.12	.10	.08	.08	.08
B. Cable						
1. Clearcut	.15	.14	.10	.05	.0	
2. Overstory Removal	.10	.06	.02	.0		
C. Helicopter						
1. Clearcut & Seed Tree	.10	.09	.05	.02	0	
2. Overstory Removal	.05	.05	.05	0		
3. Sanitation/Salvage	.02	0				
4. Selection/Thinning	.05	.02	.01	0		
III. SITE PREPARATION METHOD (Assuming good ground cover is maintained)						
A. Mechanized						
1. Pile & Burn	.15	.12	.10	.05	.05	.05
2. YSM Tractor	.10	.08	.05	.03	.03	.03
3. YSM Cable	.05	.02	0			
4. Crush/Chip	.04	.02	.02	.02	.02	.02
B. Nonmechanized						
1. Broadcast Burn L-M	.08	.05	.02	0		
2. Hand pile & burn	.05	.02				
3 Lop & scatter slash	0					
C. Herbicides	0	.05	0			
D. Rip/obliterate skidtrails	-.08	-.08	-.08	-.08	-.08	-.08
E. Hand Grubbing	.10	.05	0			
F. Disc (not plowed)	.07	.05	.02	0	0	0
VI. WILDFIRE (Strong hydrophobic conditions could double coeficient)						
A. Crown (0-10% GC)	.30	.30	.20	.10	.05	0
B. High Int (10-40% GC)	.18	.15	.10	.05	0	
C. Mod Int (40-60% GC)	.05	0				
D. Low Int (60+% GC)	0					

ERODA Coefficient Codes

ERODA Activity Code	Land Management Activity	Coefficients A	Coefficients B	SRS Database Codes Activity	SRS Database Codes Method
1	Tr Patch Clearcut	0.26	-0.05	4111	420
2	Tr Strip Clearcut	0.26	-0.05	4112	420
3	Tr Stand Clearcut	0.26	-0.05	4113	420
4	Tr Shltrwd Prep Cut	0.22	-0.04	4121	420
5	Tr Seed Tree Prep Cut	0.26	-0.05	4122	420
6	Tr Shelterwood Seed	0.22	-0.04	4131	420
7	Tr Seedtree	0.26	-0.05	4132	420
8	Tr Shltrwd Removal	0.22	-0.04	4141	420
9	Tr Seedtree Removal	0.26	-0.05	4142	420
10	Tr Overstory Removal	0.18	-0.03	4143	420
11	Tr Ind. Tree Selection	0.13	-0.02	4151	420
12	Tr Group Selection	0.13	-0.02	4152	420
13	Tr Thinning	0.13	-0.02	4220	420
14	Tr Salvage	0.13	-0.03	4230	420
15	Tr Sanitation	0.13	-0.03	4232	420
16	Tr Special Cut	0.13	-0.03	4240	420
19	Cab Clearcut	0.17	-0.05	4113	432
20	Cab Ovrstry Removal	0.10	-0.04	4143	432
21	Cab Thinning	0.01	-0.02	4220	432
24	Heli Patch Clearcut	0.10	-0.03	4111	480
25	Heli Strip Clearcut	0.10	-0.03	4112	480
26	Heli Stand Clearcut	0.10	-0.03	4113	480
27	Heli Shltrwd Prep Cut	0.02	-0.03	4121	480
28	Heli Seed Tree Prep Cut	0.02	-0.03	4122	480
29	Heli Shltrwd Seed	0.10	-0.03	4131	480
30	Heli Seedtree	0.10	-0.03	4132	480
31	Heli Shltrwd Removal	0.10	-0.03	4141	480
32	Heli Seedtree Removal	0.10	-0.03	4142	480
33	Heli Overstory Removal	0.06	-0.02	4143	480
34	Heli Ind. Tree Selection	0.02	-0.03	4151	480
35	Heli Group Selection	0.02	-0.03	4152	480
36	Heli Thinning	0.02	-0.03	4220	480
37	Heli Salvage	0.02	-0.03	4230	480
38	Heli Sanitation	0.02	-0.03	4232	480
39	Heli Special Cut	0.02	-0.03	4240	480
42	HF Thinning	0.00	-1.23	4220	490
70	Crown Fire	0.32	-0.09		
71	High Intensity Fire	0.19	-0.06		
72	Mod. Intensity Fire	0.05	-0.07		
88	Hand Grub				
89	Herbicide				
90	Tr Pile & Burn	0.13	-0.03		
91	Tr YUM	0.09	-0.02		
92	Broadcast Burn	0.08	-0.03		
93	Discing	0.07	-0.03		
94	Crush & Chip	0.03	-0.04		
95	Hand Pile & Burn	0.09	-0.02		

Eroda uses the codes 1 thru 95 for values in Land Disturbance tables. The natural log model Y=A+B*LN(X) forms a recovery curve for each disturbance. "A" & "B" are coeficients derived through a best fit regression where baseline data for X (years since activity) & Y (recovery coeficient) are derived from Kuehn, 1988. Eldorado NF

		ERODA Coefficients YEAR					
		1	2	5	10	20	30
1	Tr Patch Clearcut	0.26	0.23	0.18	0.15	0.12	0.10
2	Tr Strip Clearcut	0.26	0.23	0.18	0.15	0.12	0.10
3	Tr Stand Clearcut	0.26	0.23	0.18	0.15	0.12	0.10
4	Tr Shltrwd Prep Cut	0.22	0.19	0.15	0.13	0.10	0.08
5	Tr Seed Tree Prep Cut	0.26	0.23	0.18	0.15	0.12	0.10
6	Tr Shelterwood Seed	0.22	0.19	0.15	0.13	0.10	0.08
7	Tr Seedtree	0.26	0.23	0.18	0.15	0.12	0.10
8	Tr Shltrwd Removal	0.22	0.19	0.15	0.13	0.10	0.08
9	Tr Seedtree Removal	0.26	0.23	0.18	0.15	0.12	0.10
10	Tr Overstory Removal	0.18	0.16	0.14	0.12	0.09	0.08
11	Tr Ind. Tree Selection	0.13	0.12	0.11	0.10	0.09	0.08
12	Tr Group Selection	0.13	0.12	0.11	0.10	0.09	0.08
13	Tr Thinning	0.13	0.12	0.11	0.10	0.09	0.08
14	Tr Salvage	0.13	0.11	0.09	0.07	0.05	0.04
15	Tr Sanitation	0.13	0.11	0.09	0.07	0.05	0.04
16	Tr Special Cut	0.13	0.11	0.09	0.07	0.05	0.04
19	Cab Clearcut	0.17	0.13	0.08	0.05	0.01	-0.01
20	Cab Ovrstry Removal	0.10	0.06	0.03	-0.01	-0.04	-0.05
21	Cab Thinning	0.01	0.00	-0.02	-0.03	-0.04	-0.05
24	Heli Patch Clearcut	0.10	0.08	0.05	0.03	0.01	0.00
25	Heli Strip Clearcut	0.10	0.08	0.05	0.03	0.01	0.00
26	Heli Stand Clearcut	0.10	0.08	0.05	0.03	0.01	0.00
27	Heli Shltrwd Prep Cut	0.02	-0.00	-0.03	-0.05	-0.07	-0.08
28	Heli Seed Tree Prep Cut	0.02	-0.00	-0.03	-0.05	-0.07	-0.08
29	Heli Shltrwd Seed	0.06	0.05	0.03	0.02	0.00	-0.00
30	Heli Seedtree	0.10	0.08	0.05	0.03	0.01	0.00
31	Heli Shltrwd Removal	0.06	0.05	0.03	0.02	0.00	-0.00
32	Heli Seedtree Removal	0.02	-0.00	-0.03	-0.05	-0.07	-0.08
33	Heli Overstory Removal	0.06	0.05	0.03	0.02	0.00	-0.00
34	Heli Ind. Tree Selection	0.02	-0.00	-0.03	-0.05	-0.07	-0.08
35	Heli Group Selection	0.02	-0.00	-0.03	-0.05	-0.07	-0.08
36	Heli Thinning	0.02	-0.00	-0.03	-0.05	-0.07	-0.08
37	Heli Salvage	0.02	-0.00	-0.03	-0.05	-0.07	-0.08
38	Heli Sanitation	0.02	-0.00	-0.03	-0.05	-0.07	-0.08
39	Heli Special Cut	0.02	-0.00	-0.03	-0.05	-0.07	-0.08
42	HF Thinning	0.00	-0.85	-1.98	-2.83	-3.68	-4.18
70	Crown Fire	0.32	0.26	0.19	0.13	0.07	0.03
71	High Intensity Fire	0.19	0.15	0.09	0.05	0.01	-0.02
72	Mod. Intensity Fire	0.05	-0.00	-0.07	-0.12	-0.17	-0.20
88	Hand Grub						
89	Herbicide						
90	Tr Pile & Burn	0.13	0.11	0.09	0.07	0.05	0.04
91	Tr YUM	0.09	0.08	0.06	0.05	0.03	0.03
92	Broadcast Burn	0.08	0.05	0.02	-0.00	-0.03	-0.04
93	Discing	0.07	0.05	0.02	-0.00	-0.02	-0.03
94	Crush & Chip	0.03	0.01	-0.03	-0.05	-0.08	-0.09
95	Hand Pile & Burn	0.09	0.08	0.06	0.05	0.03	0.03

APPENDIX D - ERA COEFFICIENTS FOR GRAZING

Conversion of Range Use Data Into Equivalent Roaded Acres (ERA) on the Eldorado National Forest

In response to the need to determine the land disturbance characteristics of the Eldorado NF grazing program (R-5 FSH 2509.22 Soil and Water Conservation Handbook - 23.64 Land Disturbance), an interdisciplinary team developed the following process to evaluate the effects of range management activities in the Forest's current CWE analysis process. The team including the following member:

John Chatoian	RO-CWE/Geology
Chuck Mitchell	ENF-Soils
Diana Brink	ENF-Range
Skip Barndt	Lolo NF-Soils
Joan Carlson	ENF-Hydrology
Christine Christiansen	ENF-Hydrology

The team reviewed information on Range CWE assessment procedures collected from Forest throughout the Region 5. This information was utilized as the basis for developing the Eldorado's grazing assessment process.

Transitory Range

The team reviewed the potential watershed disturbance associated with transitory range use. The following conclusion where reached:

Range cattle for the most part do not utilize portions of the watershed on slopes greater than 30 percent

The highest potential for grazing impact outside of a SMZ and Riparian areas occur in areas opened up by our management activities or natural events.

The IDT concluded that this grazing activity produces no significant site disturbance that can modeled in our CWE process for the following reasons:

The team thought a tractor clearcut represent a management practice that has the highest probability of showing impacts associated with transitory range grazing.

Cattle enter the ranges under soil conditions that limit the potential for soil compaction.

Cattle do disturb the soil surface but the potential for accelerated erosion is limited do to the disperse nature of the use and adequate ground cover is prescribed to limit erosion potential in areas of high use.

The IDT assumed Best Management Practices and Soil Quality Standards are applied.

Brushfields and openings associated with low site areas represent other areas in the transitory range that have a higher potential to show impacts from grazing. The team concluded that grazing activities in these area produce no significant site disturbance that can be modeled in our CWE process for the following reasons:

Bushfields found on the Eldorado are generally mature, dense and mostly located on steeper slopes. Grazing disturbance is usually along the perimeter or along occasional paths through the brush fields.

Open areas don't grow much forage that is highly utilized by cattle and cattle don't tend to concentrate in these areas because they are hot and lack water sources.

Riparian Range

The IDT reviewed the potential impacts that could occur in rangelands used in the riparian areas. The following conclusion were reached about impacts in these areas:

Impacts from grazing along Class IV drainages is low because utilization is minimal because riparian forage is absent.

Along perennial and intermittent streams the amount of range use increased because of the increased amount of riparian forage.

Impacts from grazing is mainly associated with the 100 ft riparian zone along each side of these stream systems. LMP prescribed SMZ widths would over estimate the area of potential impact because these zones often extend beyond this 100 ft riparian zone and are located on slopes over 30 percent.

Following grazing disturbance criteria developed by the Lassen and Modoc NF the following ERA numbers will be utilized in our CWE modeling process for riparian zones:

Normal grazing use will be accounted for by multiplying the riparian zone (100 ft each side of stream) acreage along each Class I/II/III stream system by an ERA disturbance factor of 0.02 ERA/acre.

For areas of known grazing impacts in the riparian zone the ERA disturbance will be multiplied by a factor of 5.0.

The IDT considered meadow systems to be more sensitive and a higher grazing use zone than general riparian areas discussed above. Following grazing disturbance criteria developed by the Lassen and Modoc NF the following ERA numbers will be utilized in our CWE modeling process for Meadow system areas:

> Normal meadow grazing use will be accounted for by multiplying the meadow acreage by an ERA disturbance factor of 0.05 ERA/acre.
>
> For meadow areas with known grazing impacts the ERA disturbance will be multiplied by a factor of 5.0.

The IDT considered corral areas to be areas of high distrubance. Corral acreage will be multiplied by an ERA factor of 1.0 ERA/acre to account for this grazing impact.

Eldorado National Forest
Range Allotments

Table 2.6

Watershed:
Prepared By:
Total Watershed Acres: 0

District: 0
Date: 0

Allotment Name	Number Cow/Calf Pairs	Acres Transitory Range	Acres Permanent Range	On Date	Off Date

Identifier	Miles	Acres	x Coeff	= ERA	Percent ERA
(Class I, II, III) Streams	0				
Riparian		0	0.02	0.00	0.00%
Meadows		0	0.05	0.00	0.00%
Damaged Riparian		0	0.10	0.00	0.00%
Damaged Meadow		0	0.25	0.00	0.00%
Corral/Holding Area		0	1.00	0.00	0.00%
		Subtotal for Grazing		0.00	0.00%

*Notes:

APPENDIX E - ERA COEFFICIENTS FOR URBAN INTERFACE

URBAN INTERFACE COEFFICIENTS

On 3/16/93 Joan Carlson and Allen Somers developed some coefficients to be used for Urban Interface areas within watersheds. These coefficients were derived from occular estimates using county zoning maps and aerial photographs.

The following is a list of the groups of zoning areas and their corresponding coefficients:

Coefficient of 0.7

I: Industrial

C: Commercial

CG: General Commercial

CPO: Professional Office Comercial

Coefficient of 0.5

R1: Single Family Residence

Coefficient of 0.2

R1A: Single Family Residential - 1 Ac. Min.

R2A: Single Family Residential - 2 Ac. Min.

R3A: Single Family Residential - 3 Ac. Min.

RE5: Estate Residential - 5 Ac. Min.

RE10: Estate Residential - 10 Ac. Min.

RF: Recreational Facility

Coefficient of 0.1

AE: Exclusive Agriculture

RA20: Residential Agriculture - 20 Ac. Min.

RA80: Residential Agriculture - 80 Ac. Min.

Use Existing Coefficients

TPZ: Timberland Preserve

OS: Open Space - Conservation

APPENDIX F - ERODA SUMMARY SHEET

ERODA

Eldoardo National Forest
Cumulative Watershed Effects
Summary

Table 2

			District:
USFS Acres:	0	0.0%	Watershed:
Private Acres:	0	0.0%	WS#:
Watershed Acres:	0	0%	Date:
			Prepared By:

Management History:

	ERA	1994	1996	1999
I. Silvicultural System				
A. Timber Removal	Table 2.1	0.0	0.0	0.0
B. Site Prep	Table 2.2	0.0	0.0	0.0
C. Landings	Table 2.3	0.0	0.0	0.0
D. Cultural Treatments	Table 2.4	0.0	0.0	0.0
II. Transportation System				
A. Roads	Table 2.5	0.0	0.0	0.0
B. Trails, 4x4,	INCLUDED ABOVE			
III. Other USFS Management Activites				
A. Range Allotments	Table 2.6	0.0	0.0	0.0
B. Mining Operations		0.0	0.0	0.0
C. Misc Impervious Areas	Table 2.7	0.0	0.0	0.0
IV. Natural Disturbances				
A. Fire Activity	Table 2.8	0.0	0.0	0.0
V. Watershed Improvements		0.0	0.0	0.0
Current ERA Total		0.0	0.0	0.0
Current Percent ERA Total		0.0%	0.0%	0.0%

Planned Future Management: (Table 2.9)	1994	1996	1999
I. Future Timber Removal (Private land)-1993	0.0	0.0	0.0
IIA. Future Timber Removal (Cox Cyn Sale)	0.0	0.0	0.0
IIB. Future Site Prep (Cox Cyn Sale)	0.0	0.0	0.0
III. Future Timber Removal (Bull Plum Sale)	0.0	0.0	0.0
IV. Road Obliterations	0.0	0.0	0.0
V. Other Future Activities-Development	0.0	0.0	0.0
VI. Future Cultural Treatments	0.0	0.0	0.0
VII. Future Improvements	0.0	0.0	0.0
Future ERA	0	0	0
Future Percent ERA Total	0.0%	0.0%	0.0%

APPENDIX G - STREAM SURVEY PROCESS

Stream Survey Procedure - 3/19/93

GOAL: Determine if the watershed is experiencing adverse CWE.
Are beneficial uses being impacted?

OBJECTIVES:
1. Characterize stream channel and riparian area condition.
2. Identify problem/actively eroding areas within the watershed.

REQUIREMENTS:
1. Adequate assessment in a short period of time.
2. Documentation--maps, photos, forms and field notes.
3. Compatible to current data base.

PROCEDURE:

1. Identify beneficial use(s) of concern in the watershed.

2. Select locations within watershed for field review.
   a. Places to look at:
      - -proposed sale area
      - -disturbed areas (logging, mining...)
      - -sensitive watershed areas (gully prone, inner gorge...)
      - -stream crossings
      - -low gradient reaches, transition reaches
      - -headwater reaches
      - -drainage patterns
      - -landings

   b. Priority criteria
      - -access
      - -where we have no info available

   c. Process:
      1. Look at existing info
         a. hydro/fish stream surveys
         b. WIN file
      2. Maps
         a. project area map
         b. GIS maps
         c. GRI, SRI
         d. topo maps
         e. stream class
      3. Air photos
         a. time series--1980ish, 1986, 1992
      4. Make master map
         a. break out logical reaches
         b. master map for office file, additional maps for field
      5. Prioritize reaches to visit in field
         a. **be sure to visit sale area**

3. Go to field
   a. see field forms

4. Documentation
   a. short summary report
   b. *statement on how well this survey describes the watershed.*

Eldorado National Forest Stream Channel Evaluation

Watershed # - Reach_____ Date_____Time_____
Stream Name_____ Legal Location_____
Rosgen Type_____ Reach Length_____
Gradient_____ Observer(s)_____

FlowWidth_____Flow Depth_____ Aggradation/Degradation(%)_____
Flow Length_____Time_____CFS_____ Riparian Zone Width (R)_____ (L)_____

Average Width_____Bankfull_____ Canopy Density ___, ___, ___, ___/ _____%
Any Fish Observed?_____ Reach length in pools (%)_____
Photo #_____ TerrVeg Type - Riparian/Pine/M.Conifer/
_____ Hardwood/Other_____

Extent of Riparian Use: 1=High 2=Moderate 3=Little 4=None
Animal Use_____Recreation Use_____

Plankuch		COMMENTS:
	UPPER BANKS	
Landform Slope (2...8)		
Mass Wasting (3...12)		
Debris Jam Potential (2...8)		
Bank Protection (3...12)		
	LOWER BANKS	
Channel Capacity (1...4)		
Bank Rock Content (2...8)		
Obstructions (2...8)		
Cutting (4...16)		
Deposition (4...16)		
	CHANNEL BOTTOM	
Rock Angularity (1...4)		
Brightness (1...4)		
Particle Packing (2...8)		
Bottom Size Distribution (4...16)		
Scouring and Deposition (6.24)		
Aquatic Vegetation (1...4)		
Adjustment		
Total		

Composition of Bottom Materials

1. Bedrock _____%
2. Boulders (>11" diam) _____%
3. Cobble (3"-11") _____%
4. Gravel (0.2"-3") _____%
5. Sand (0.04"-0.2") _____%
6. Silt&Clay (<.04") _____%

Large Woody Debris

(Minimum length 10 ft. - within bankfull channel - Use large end diameter)

12"-20"_____
>21"_____

Eldorado National Forest
Watershed Improvements Needs (WIN) Inventory

Project Identification Form — Please Return Completed Form to Hydrology-SO

District:_____ Prepared By:_____

Site Name:_____ Date:_____

Watershed:_____

Road Name/#:_____

Compartment:_____ Location: T_____R_____S_____S_____

Range Allotment:_____

Site Category: (Indicate those that apply)

Debris Clogged Channel	Sheet & Rill Erosion	Reduced Quality of Spawning Habitat
Lake or Stream Channel Erosion	Gully Erosion	Reduced Quantity of Spawning Habitat
Damaged Riparian Area	Mass Wasting	Reduced Quality of Rearing Habitat
Damaged Meadow (other than DRA)	Soil Compaction	Reduced Quantity of Rearing Habitat
Damaged Non-system Road	Abandoned Mines	Reduced Wildlife Cover
Damaged System Road	Abandoned Quarry	Reduced Wildlife Forage
Damaged Non-system Trail	Fire Damaged Areas	Reduced Dead & Downed Material
Damaged System Trail	Other:_____	Other:_____

Disturbance Source:

Animal Grazing Patterns	Waste Disposal Sites	Hydrologic Diversions/Modifications
Off Highway Vehicles	Mineral Extractions	Fire Natural Cause? (Yes/No)
Silvicultural Methods	Floods	Mass Wasting Natural Cause? (Yes/No)
Disturbed Sites (Active & Past)	Urban Runoff	Recreational (In Developed Areas)
System and Non-system Roads	Other:_____	Other:_____

Site Condition: ____Declining ____Constant ____Satisfactory ____Recovering

Stream Type: ____Perennial ____Ephemeral ____Intermittent

Non-Point Source of Pollution? (Y/N) _____

Proposed Treatment:

Mulch, Revegetate, Subsoil, or Reshape Land	Landslide Stabilization
Water Bars, Culverts, Cross drains, or Energy Dissipaters	Channel Clearing
Silt Fences, Earth Fabric, Rip Rap, Check Dams or Gabions	Pollution Abatement
Road or Landing Obliteration	Soil Productivity Enhancement
Fisheries Habitat Improvement Structures	Non-structural Fisheries Habitat Improvement
Other:_____	Other:_____

Estimated Riparian Acres to Treat: _____acres Estimated Costs of Implementation: $_____

Estimated Total Acres to Treat: _____acres Fiscal Year of Funding Request: _____

Planned Funding Sources: (Enter either amount or percentage from each)

____Timber (including KV)	____Range	____Salmon Stamp
____Wildlife and Fisheries	____Facilities	____Bosco-Keene
____Water, Soil and Air	____Protection	____AB 1705
____Minerals and Geology	____Non-Point	____Federal Facilities Compliance
____Green Sticker (OHV)	____County	____Hilt Bill (Deer Habitat Improvement)
____Challenge Cost Share	____Prop 70	____Other:_____
____Calp (Non-game Habitat)	____Prop 19	____Other:_____

On the back of this form include a short description of the site.

Please include quads and/or maps, photos or sketches.

6. Documentation

NEPA regulations (40 CFR 1500-1502) emphasize the importance of NEPA documents concentrating on significant issues, rather than amassing needless detail. Key items to consider when documenting CWE analysis are as follows:

1500.1(b) ...concentrate on issues that are truly significant to the action

1500.4(c) Discussing only briefly issues other than significant ones.

1502.2(b) Impacts shall be discussed in proportion to their significance. There shall be only brief discussion of other than significant issues.

Identification of the significance of a CWE issues on a project should be based on the following factors (FSH 1909.15):

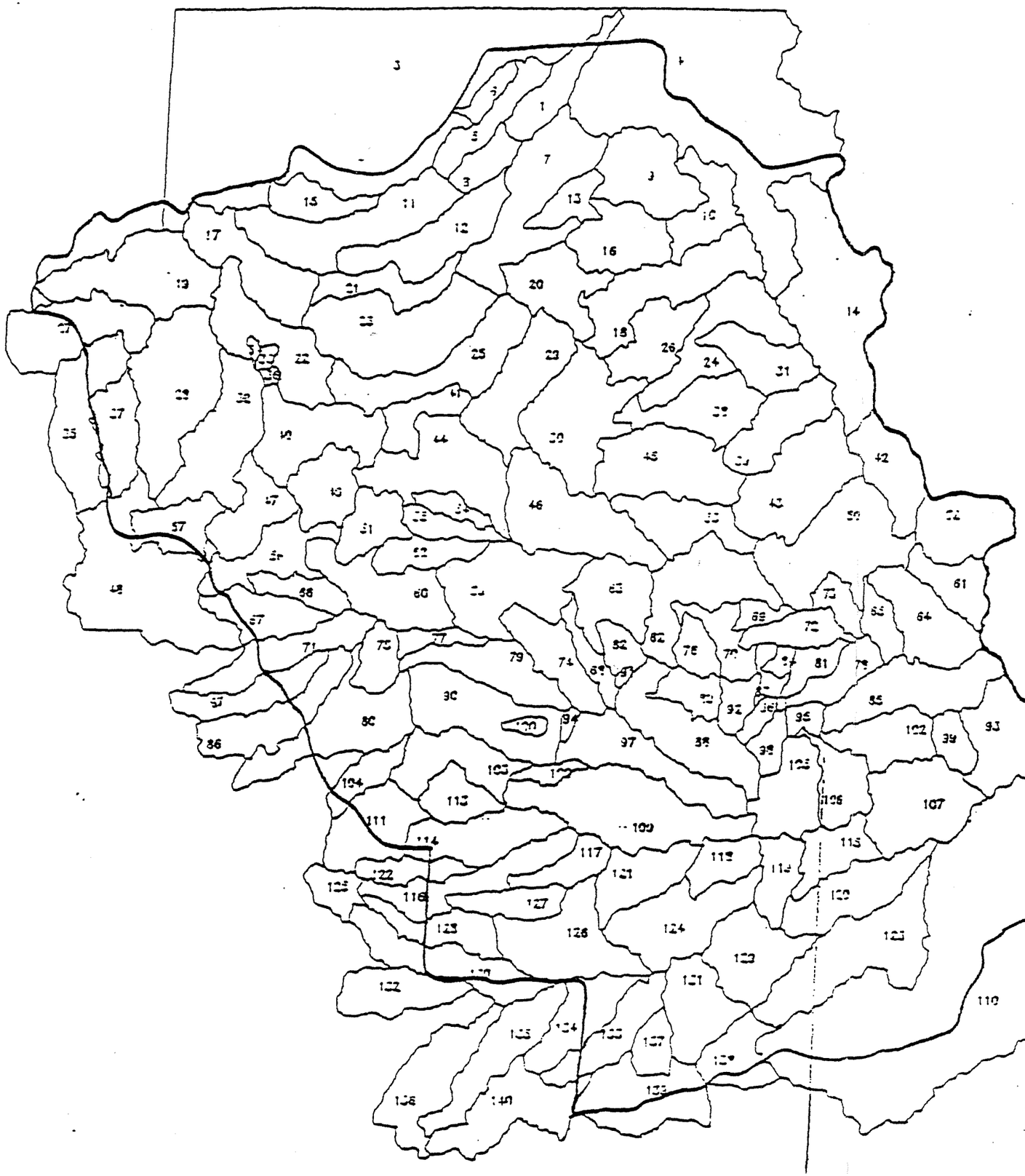
Extent the geographic distribution of the issues
Duration the length of time the issue is likely to be of interest
Intensity the level of interest of conflict generated by the issues.

CWE documentation performed as part of an environmental analysis for forest and project planning can take one of two forms (FSH 2509.22- Section 23.9) depending on the significance of the CWE risk. An assessment CWE risk can be for any project can be made by following the steps outlined in the CWE Assessment Flow Chart found in this CWE guide. In watersheds where CWE risk are unknown the following approach could be used to quickly determine risk:

1. Determine the watershed analysis area (what watershed to evaluate).
2. Estimate-via Air photos or other quick means the current level of land disturbance
3. Determine the beneficial uses of water
4. The extent of the proposed project within the identified watershed
5. Quickly estimate the current CWE risk
6. Determine if there is a need to do additional CWE work.

For projects where CWE susceptibility is not a concern requiring additional consideration in the NEPA process, documentation should include a brief narrative explaining how and why this conclusion was reached. The explanation should answer the following question:

What are the beneficial uses of concern in identified watershed?
Where do beneficial uses occur in that watershed?
How has or might land uses affect these uses?
What factors(climatic/physical/biological) influence CWE of beneficial uses?
How significant will downstream effects be?
Where will they take place?
Under what circumstance will they occur?
How long will it take the channel system and beneficial uses to recover?



ELDORADO NATIONAL FOREST
Watershed Map
May 21,1993

Forest Boundary _____

Watershed Boundary _____

CWE Assessment

ERA/TOC

ERA/TOC SCAN

ERA < 50% TOC	ERA 50% to 80% TOC	ERA 80% to 100% TOC	ERA OVER 100% TOC
LOW RISK	MODERATE RISK	HIGH RISK	VERY HIGH RISK

Quality of Watershed/ Channel Information

GOOD	POOR	GOOD	POOR	GOOD	POOR	GOOD	POOR
Air Photo.Interpr. Any Old Surveys	No Photo.Interpr. Sole Reliance On Outdated Surveys	Spot Field Observ. And Photo Interp.	Air Photo.Interpr. Only Old Data	WIN. Survey Entire Watershed For Condition. Air Photo Interp.	Spot Field Observ Air Photo Interp. Old Data	Watershed & Channel Condition Surveys Complete. Process & Activity is Scoped On Assessment. WIN, & CHA Of Sensitive Lands And In-Channel Data.	Watershed Survey Air Photos

Watershed/Channel Condition

GOOD	POOR	GOOD	POOR	GOOD	POOR	GOOD	POOR	GOOD	POOR	GOOD	POOR	GOOD	POOR	GOOD	POOR
		UNKNOWN				UNKNOWN				UNKNOWN				UNKNOWN	

Additional Field/Photo Work Evaluation

Additional Evaluation	Additional Evaluation	Additional Evaluation	Additional Evaluation	Additional Evaluation	Additional Evaluation	Additional Evaluation	Additional Evaluation

Assess Affects of Proposed Action and/or Recommend Mitigation

Project Assess-ment	Project Assess-ment	Project Assess-ment	Project Assess-ment	Project Assess-ment	Project Assess-ment	Project Assess-ment	Project Assess-ment	Project Assess-ment	Project Assess-ment	Project Assess-ment